



November 1996

Peabody Optimizes Pumping System

"Joining the Motor Challenge Showcase Demonstration project team provided the needed impetus to find inefficiencies in our procedures and identify the best, most cost-effective ways to improve system efficiency," explains Ron Cross of Peabody Holding Company. And that is just what Peabody Holding did in yet another successful Motor Challenge Showcase Demonstration.

Peabody Holding, the largest U.S. coal producer, recently completed a project to improve the energy efficiency of a coal slurry pumping system at its Randolph Coal Preparation Plant. The project focused on changing three components of the pumping system—the motor, the belt drive, and the pump—and resulted in energy cost savings of \$5,000 annually. Similar improvements could be applied to, and benefit, many other pump systems at Peabody Holding's nationwide facilities.

Peabody Holding Company hosted this Showcase Demonstration project. Other



The Showcase Demonstration project team: (back row) Peabody, GIW, U.S. Electrical Motors, Illinois Power Company; (front row) project electrician and Preparation Plant superintendent.

project participants included U.S. Electrical Motors, Georgia Iron Works (GIW) Industries, Inc., Illinois Power Company, and The Benham Group. DOE conducted an independent performance validation to verify the project results.

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IN REMEMBRANCE

Robert Allen, the Regional Representative of the Motor Challenge at the U.S. Department of Energy's Boston Support Office, passed away Wednesday, October 10, 1997. Motor Challenge will deeply miss Bob's enthusiasm and hard work. Bob actively promoted Motor Challenge in many ways. He organized the program's regional network in the northeast and assisted in organizing and hosting a highly successful Performance Optimization workshop in September for the Motor Challenge. He was also instrumental in working with Account Manager Bill Orthwein to recruit Allied Partners to Motor Challenge in the northeast.

Bob had been with DOE in Boston since 1974 when it was known as the Federal Energy Office. He was well known as the lead of the State Energy Conservation Program and the Energy Extension Service for the New England region. He was highly involved in planning national meetings with the states. Bob was the northeast representative for the Federal Laboratory Consortium and the only nonlaboratory member to be granted voting rights with the Consortium. In addition to his work on Motor Challenge, Bob supported other OIT programs, such as Climate Wise, NICE³, and the Industrial Assessment Centers. He is survived by his wife Heather and two sons, Seth and Myles.

Allied Partners Surpass 75



The number of organizations that have joined Motor Challenge as Allied Partners has now surpassed 75. But not only is the number of

Allied Partners growing, so are the types of activities these Allied Partners are undertaking. Some examples of recent actions taken by Motor Challenge's Allied Partners are listed below.

Arkansas Energy Office invited Motor Challenge Account Manager Bill Orthwein to participate in the first of five workshops to acquaint the state's manufacturers with the Motor Challenge Program and show how improving motors and motor-driven systems can benefit business.

Detroit Edison developed a two-day Motor Systems Conference specifically for energy management professionals of the Chrysler Corporation. Motor Challenge representatives demonstrated *MotorMaster+* and presented additional Motor Challenge materials available to Allied Partners.

Grand River Dam in Oklahoma, serving rural cooperative utilities, industries, and municipalities, held a customer conference on October 8, 1996. At the workshop, Grand River Dam distributed Motor Challenge information to their industrial end users. Attendees also took part in discussions on customer service and regulatory matters.

Dreisilker Electric Motors, Inc., in Illinois is working with one of its large industrial clients on a Total Motor Management effort that includes development of a repair/replace policy, a preventive/predictive maintenance strategy, and an overall plant motor retrofit. This retrofit will target units whose performance was identified

and analyzed using *MotorMaster+*. Dreisilker plans to work with other industrial clients who have expressed an interest in this type of proactive approach.

Heights Armature Works, a repair shop based in Houston, is helping industrial customers make informed choices when selecting motors using Motor Challenge software, training materials, and technical publications. Heights Armature has provided *MotorMaster+* to and is working with Conoco, Phillips Petroleum, and International Cellulose. Heights' work with International Cellulose has caused them to update their preventative maintenance, begin a motor inventory, and consider full-time monitoring of key motors via computer hookup. This effort will help prevent potential future shutdowns and production losses.

The Northern States Power Company in Minnesota has distributed through its network of Account Executives large quantities (i.e., 250) of the *MotorMaster+* software and various publications on energy-efficient motor systems. Northern

States Power will be using Allied Partner resources to complement its efforts to provide comprehensive education and training.

Northeast Utilities, serving Connecticut, New Hampshire, and Western Massachusetts, is planning to replicate Motor Challenge's Performance Optimization workshops for key municipal districts in Connecticut. Account Manager Bill Orthwein presented the Motor Challenge Allied Partnership and the *MotorMaster+* software to Northeast Utilities' many sales and account representatives at an October 2 event. The information presented to these representatives assists them in their work with industrial end users.

If your organization works with industry, you too might be interested in learning more about how Allied Partners are using Motor Challenge materials and tools to provide increased information and support to their customers. Call the Motor Challenge Hotline at (800) 862-2086 for information on becoming an Allied Partner.



TECH TIP

How to Begin a Motor Efficiency Improvement Program

The first step to beginning a motor efficiency improvement program is to survey your motors, gathering nameplate information and obtaining field measurements (i.e., voltage, amperage, power factor, and operating speed) under typical operating conditions. Initially focus on non-specialty motors that have been rewound, are oversized, and operate at least 2000 hours per year. Then conduct motor replacement analyses (using MotorMaster+ software) and divide your motors into three categories:

Replace immediately: motors offering rapid payback through energy savings, improved reliability, or utility rebates.

Replace at time of failure: motors with intermediate payback. Contact motor dealers to review the efficiency and prices of available energy-efficient motors. You may purchase

the motor to keep on hand as a spare or wait to purchase it until the existing motor fails. Leave present situation as is: motors with extended payback. These motors are already reasonably efficient or are used less than 2000 hours each year.

The cost of running a motor may increase significantly in the future. Thus, energy efficiency improvements that are not justified today may become worthwhile in a few years, so periodically reevaluate payback and reliability. It is also important to operate your motor efficiently. For more information, contact the Motor Challenge Information Clearinghouse at (800) 862-2086 and ask for a copy of the fact sheet, Buying an Energy-Efficient Electric Motor.

MEET THE MOTOR CHALLENGE ALLIED PARTNER TEAM

Chris Cockrill, U.S. Department of Energy Manager, Motor Challenge Allied Partnership

Chris Cockrill currently manages the new Motor Challenge Allied Partnership and oversees the development of Motor Challenge tools and technical/training materials.

Chris began his career with DOE in 1986 at the Kansas City Regional Support Office where he worked on energy efficiency programs for buildings and facilities. Since 1992, Chris has been a key player in developing and launching the Motor Challenge. He has worked with many private, state, and regional organizations on numerous motor system efficiency efforts.

Prior work experience includes curriculum management, materials development, training delivery, and operation of four mid-west regional training facilities for Midland Energy Institute. Chris was also the manager of a state-wide energy program for schools and hospitals in Missouri.

Bill Orthwein and Jonathan Stine Allied Partner Account Managers

Bill Orthwein and Jonathan Stine assist Allies in their efforts to provide added value to their customers using Motor Challenge products and services, such as publications, decision support software, and training. They are developing networks with regional power marketing organizations, electric utilities, motor distributors, engineering firms, energy service companies (ESCOs), and other organizations that support the industrial end user as Allies of the Motor Challenge.



Bill Orthwein is an Allied Partner Account Manager for the northeast, midatlantic, south, and southeastern regions.

Recently, Bill provided analytical and project support to DOE, the U.S. Environmental Protection Agency, and the General Services Administration. He has expertise in many areas, including energy management, energy and environmental policy, energy auditing, energy efficiency retrofit financing, and performance contracts. Bill is a Certified Energy Manager.



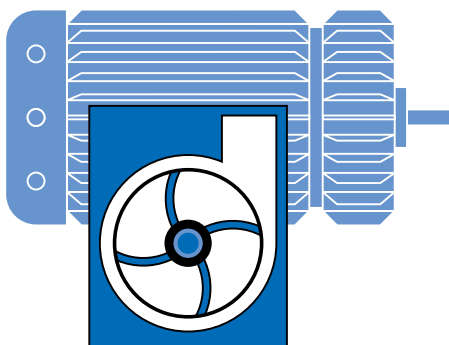
Jonathan Stine is an Allied Partner Account Manager for the western/midwestern region.

While with the Washington State Energy Office's Energy Ideas Clearinghouse, Jonathan performed many duties including that of the Motor Challenge Information Clearinghouse Manager. As the Clearinghouse Manager, he provided customer service and technical assistance to Motor Challenge Partners and potential Partners. Jonathan was also instrumental in developing the Motor Challenge Partner database, the Bulletin Board, and the World Wide Web site.

Performance Optimization Workshops Completed

Motor Challenge successfully completed its five-city performance optimization workshop series targeted at the water and wastewater industry. Workshops were held in Orlando, Florida; Boston, Massachusetts; Denver, Colorado; Pittsburgh, Pennsylvania; and Milwaukee, Wisconsin. More than 500 participants from local utilities, city water departments, rural water associations, engineering companies, and others organizations attended the workshops. The

workshops presented the concepts of performance optimization, provided a pre-screening tool for attendees to analyze the opportunity for optimization of their pump systems, and presented case studies on the application of performance optimization in the water and waste-water industry. Overall, participants were extremely pleased with the outcome. As stated by participant Bob Elmquist, Water Resource Supervisor for the City of Apopka, Florida, "the workshops were very informative and extremely useful. The information they provided on technologies and resources helped us open our minds and think of different options to improve our pump systems." Motor Challenge hopes the tools provided at the workshops will help local governments across the country operate their pump systems more efficiently.



NEW PRODUCTS AVAILABLE

The following products are now available from the Motor Challenge Information Clearinghouse:

- 3M Showcase Demonstration Case Study
- Lockheed Martin Showcase Demonstration Case Study
- Showcase Demonstration Project Summaries
- Energy-Efficient Electric Motor Selection Handbook
- Frequently Asked Questions on the Impacts of the Energy Policy Act of 1992
- Buying an Energy-Efficient Electric Motor fact sheet
- Optimizing Your Motor-Driven System fact sheet
- Reducing Power Factor Cost fact sheet
- Replacing an Oversized and Underloaded Electric Motor fact sheet

These products are available to participants of the Motor Challenge. Call the Clearinghouse at (800) 862-2086 for ordering information.

DOE's Industrial Energy Partnerships

Several partnership programs in DOE's Office of Industrial Technologies (OIT), including Motor Challenge, are working with U.S. industry to help improve their productivity while increasing energy efficiency and preventing pollution. These programs include:

NICE³—Sponsors one-time matching grants up to \$400,000 to industry/state partnerships for projects that develop and demonstrate advances in energy efficiency and clean production technologies. NICE³ is currently soliciting grant applications until January 15, 1997. Contact Amy Johnson, NICE³ Program, at (303) 275-4716 for information on the solicitation process.

Climate Wise—A cooperative effort between DOE and the Environmental Protection Agency that has over 200 partners. Fortune 500 companies, such as Dow Chemical and General Motors, as well as small companies like Majestic Metals and ETNA Industries are working together, sharing information, and developing innovative

ways to save energy and reduce greenhouse gas emissions.

Industrial Assessment Centers (IACs)—Conduct industrial assessments for small to medium-sized manufacturers and provide recommendations to help them identify opportunities to improve productivity, reduce waste, and save energy. Audits are available at no cost to the manufacturer. There are currently 30 IACs in operation, located at universities across the country.

Inventions and Innovation Program—Provides technical evaluation services and pre-venture financial assistance to independent inventors and small technology based businesses. Over 500 technology development grants, averaging \$93,000, have resulted in energy savings of \$1 billion.

For more information on any of these Energy Partnerships programs, please call the Energy Efficiency and Renewable Energy Clearinghouse at (800) DOE-EREC or access the OIT home page at www.oit.doe.gov.

We Want Your Input

The *Motor Challenge Sourcebook* is a compendium of activities and resources in the electric motor systems markets. Its purpose is to better inform stakeholders of current efforts for improving the performance of motor systems. Motor Challenge will be updating the Sourcebook next year and is seeking comments and feedback from Partners and Allied Partners. We are considering dividing the Sourcebook into separate documents based on system type, including motors and drives, pumps, fans and blowers, and air compressors. Each document would include information on taking a systems approach, best practices, and relevant resources, such as Motor Challenge Allied Partners. We would like to know if you feel these proposed changes would be an improvement. Your comments concerning the following would also be helpful:

- What do you feel is the most useful part of the Sourcebook?
- What would you like to see added to the Sourcebook?

- What do you feel is the least useful part of the Sourcebook?
- What other ways would you improve the format of the Sourcebook?

Send us your comments by e-mail to sourcebook@rdcnet.com, or fax to (703) 356-2230.

The Sourcebook is available at no charge to Motor Challenge Partners and Allied Partners and at a cost of \$4.50 to others. To obtain a copy of the Sourcebook, call the Motor Challenge Information Clearinghouse at (800) 862-2086.



Peabody Optimizes Pumping System

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As a result of modifications to the coal washing process over the last few years, the plant's six cyclone pumps were larger than necessary for system requirements, causing inefficient energy consumption. Each pump was equipped with a 10" suction, 10" discharge and a 32" diameter impeller, and driven by a 100-horsepower standard motor through a V-belt drive. Out of heightened concern for the environment and recognizing the practical benefits of energy efficiency, Peabody initiated the optimization of one of the six pumping systems to more efficiently match system requirements. The company installed a high efficiency model in place of the standard efficiency motor, replaced the V-belt drive with a toothed belt drive, and replaced the original pump volute and impeller with a smaller volute and new impeller.

In addition to the cost savings, Peabody Holding realized other benefits, such as reduced future replacement costs for the smaller size pump volute.

This project has broad applications for Peabody Holding and the coal industry. "All coal washing facilities must pump coal slurry. The results of this Showcase Demonstration project provide these facilities with useful information on methods for improving their pumping system efficiencies," states Ron Cross.

SHOWCASE DEMONSTRATIONS

Motor Challenge's Showcase Demonstration projects target electric motor-driven system efficiency and productivity opportunities in specific industrial applications. The teams, led by industrial end users of motor-driven systems, host and fund the design, construction, and operation of projects to improve the efficiency of electric motor systems. DOE provides technical assistance, performance validation, and communication of the results. For copies of Showcase Demonstration case studies, contact the Motor Challenge Information Clearinghouse at (800) 862-2086.



The Guest Column

The Guest Column is a new Turning Point feature that will spotlight different authors from various organizations. The articles presented provide technical news of interest to users of motor systems.

Assessment and Testing of Available Methods for Evaluating In-Service Motor Efficiency
By Craig Wohlgemuth, Bonneville Power Administration

Managing electric motor systems is one of the most important aspects of improving reliability and increasing energy savings in the industrial environment. To assess the "health" of an operating motor and determine replacement options in the event of a future failure, it is important to understand as much about the motor as possible given the constraints of an operating industrial facility. Information such as nameplate data, current, voltage, speed, and other parameters can be determined from field measurements. However, one of the most difficult items to determine in the field is the motor's actual operating efficiency.

To correctly calculate the economics of replacing an operating motor (particularly one that may have been repaired several times) requires a reasonably accurate knowledge of the operating environment, including efficiency and the load imposed on the motor by the driven equipment. Also, the restriction that the motor efficiency be estimated without removing the motor from service places severe demands on the method(s) selected. Various techniques have been developed to estimate motor efficiency and load, but all have their weaknesses.

As a first step toward solving this problem, the Bonneville Power Administration (BPA), Pacific Gas and Electric (PG&E) Company, and the U.S. DOE Motor Challenge sought expertise at the Oak Ridge National Laboratory to investigate and assess all known methods for evaluating in-service efficiency of motors. The objective was to locate and review every available field efficiency estimation method or technique that could be found in a

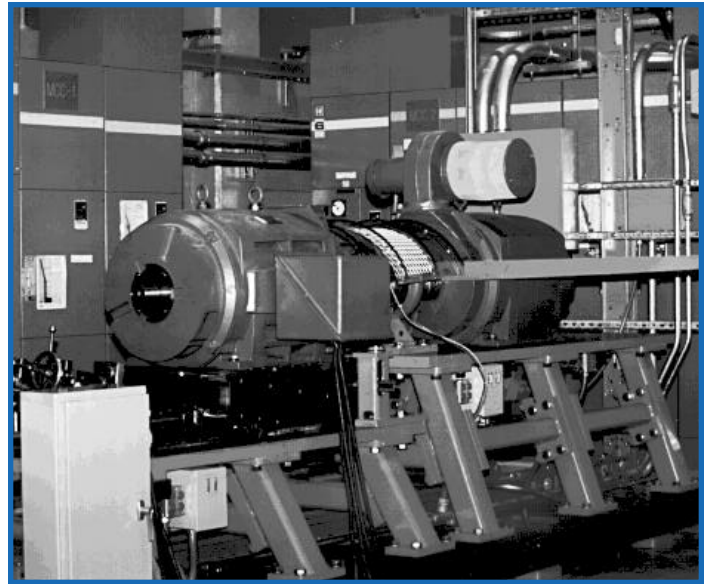
literature search.

The survey looked primarily for methods that could be used during motor operation without removing the motor from service. The search included commercially available methods and methods theoretical in nature. Each "found" method was evaluated according to 16 criteria which included invasiveness, economy, portability and accuracy, and measurement requirements such as input power, full- and no-load current, stator resistance, and speed. Finally, each method was assigned an overall "Grade Point Average" based on the combined ratings for each criterion.

Twenty-eight methods were ultimately selected for analysis and inclusion in the study, completed in April of 1996. In general, these methods estimate the motor's efficiency by measuring some combination of the current, voltage, power-in and speed and other parameters unique to each motor. In most methods, the motor's efficiency is calculated using an equivalent circuit model or other mathematical representation of the motor.

Although the 28 methods were reviewed and evaluated on several criteria, no comprehensive laboratory testing to assess accuracy and precision has been done. To accomplish this step, BPA and PG&E (with technical support and guidance from Motor Challenge staff) have contracted with the Washington State University (WSU) Cooperative Extension Energy Program.

First, WSU reviewed the Oak Ridge study and selected the most promising efficiency testing methods that would meet BPA and PG&E criteria for accuracy and invasiveness. They also included several additional methods that were developed after the Oak Ridge study was completed.



Phase II laboratory testing is being performed at this Motor Systems Resource Facility, EPRI/BPA Center at Oregon State University.

Based on an analysis of these methods, WSU, in cooperation with the Motor Systems Resource Facility at Oregon State University, developed a detailed test protocol to perform comprehensive side-by-side comparison tests of all selected methods. Real world situations will be simulated by testing two good motors (60 and 300 horsepower) and two rewound motors with known flaws or degraded conditions at both nominal and typical (off nominal) conditions. The accuracy of the selected methods will be evaluated for a multi-dimensional matrix of input voltage, load level, motor horsepower, and condition. Each motor will have efficiency measured using IEEE 112, method B. Concurrently, each motor will have its efficiency measured by each of the methods under investigation. Similar testing will be conducted with conditions modified from standard IEEE 112B, such as phase unbalance, over/under voltage, and warm/cold ambient conditions.

Actual laboratory testing is expected to be completed by December. Final results and test report should be available by April 1997. For more information contact:

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fax (503) 230-4973
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Coming Events in 1996-1997

December 11-12, 1996	West Coast Energy Management Congress, Anaheim, CA; call (770) 279-4386
January 21, 1997	Midwest Motor Systems Consortium Training, Milwaukee, WI; call Angela Prestil (608) 238-4601 or e-mail to aprestil@ecw.org
January 23	Innovative Financing Results (workshop on tools for financing energy efficiency and pollution prevention projects), Denver, CO; call John Beldock (303) 674-0803
January 28	<i>MotorMaster+</i> Training, Energy Center of Wisconsin, Madison, WI; call Angela Prestil (608) 238-4601 or e-mail to aprestil@ecw.org
February 5	<i>MotorMaster+</i> Training, Energy Center of Wisconsin, Milwaukee, WI; call Angela Prestil (608) 238-4601 or e-mail to aprestil@ecw.org
February 6	<i>MotorMaster+</i> Training, Energy Center of Wisconsin, Brookfield, WI; call Angela Prestil (608) 238-4601 or e-mail to aprestil@ecw.org
February 11	Midwest Motor Systems Consortium Training, Madison, WI; call Angela Prestil (608) 238-4601 or e-mail to aprestil@ecw.org
February 18-19	Carolina Plant Engineering & Maintenance Show, Greenville, SC; call (510) 354-3131
February 24-27	Industrial Energy Efficiency Symposium & Expo, Arlington, VA, sponsored by DOE; contact Energetics Inc., by fax at (301) 621-3329 or e-mail to oit.expo97@hq.doe.gov
March 10-13	45th Annual Design Engineering Show/National Manufacturing Expo, Chicago, IL; call (203) 840-5366



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INFORMATION CLEARINGHOUSE

Do you have questions about using energy-efficient electric motor systems? Call the Motor Challenge Information Clearinghouse for answers, Monday through Friday 9:00 a.m. to 8:00 p.m. (EST).

HOTLINE: (800) 862-2086

Or access our homepage at www.motor.doe.gov

TURNING POINT



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